1. a) Find the magnitude & sign of the torques due to each of the weights and forces in the diagram below relative to point P.

\[ \begin{array}{cccc}
14.0 \text{ N} & 0.5 \text{ m} & 36 \text{ N} \\
1.0 \text{ m} & 1.0 \text{ m} & 0.5 \text{ m} \\
10 \text{ N} & 5.0 \text{ N} & 5.0 \text{ N} & 30 \text{ N}
\end{array} \]

b) Repeat question (a) but recalculate torques relative to point Q.

c) Compare sum of torques in part (a) and in part (b). Don't forget about (+) and (-) torques. Can you change the location of the pivot point without changing the result?

2. The diagram below represents the forearm of a person holding a 1.2 kg ball in his hand, located at 0.35 m from the elbow joint. The arm has a mass of 1.4 kg. The biceps muscle which pulls the arm upwards is attached to the bone at a distance 0.05 m from the elbow joint. How much force must the biceps produce to keep the arm & ball in equilibrium in a horizontal position?
3. A bag of dirt is to be carried by two women by hanging it from a 3.0 kg pole, 2.0 m long as shown in the diagram below. To lift the pole and bag of dirt one woman must lift one end with a force of 480 N and the other woman at the opposite end with a force of 360 N. What is the mass of the bag of dirt and where is it located?

4. A diving board 3.0 m long is supported at a point 1.2 m from the end and a 720 N diver stands on the free end as shown below. The uniform board weighs 42 N.

Find the force \( F_2 \) at the support point and the force \( F_1 \) at the end that is held down.
5. A shelving unit is set as shown below with a light wire support rated at 695 N tensional force. The uniform shelf has a mass of 2.0 kg.

a) What is the maximum weight that can be placed at the end of the shelf without having it fall down?

b) Find the forces in the X and Y direction acting at the hinge (pivot).

6. A "boom" crane is being designed to lift 75 tonnes (75000 kg) when the weight is placed at 3/4 of its length away from its pivot point as shown in the diagram below. The "boom" itself has a mass of 320 kg.

a) What should the minimum tension force rating on the supporting wire be?

b) What is the resultant (or net) force at the hinge?
7. A 15.0 kg ladder that is 9.5 m long leans against a wall making an angle of 68° from the horizontal floor as shown in the diagram below. A 65.0 kg woman painter is standing on the ladder 2/3 of the way up.

\[ F_f \]

\[ F \]

\[ \theta = 68° \]

/ 4 a) Calculate the force of friction that currently exists between the bottom of the ladder and the floor to keep the ladder from sliding away.

/ 2 b) What is the minimum value of the coefficient to produce this force of friction?